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An analysis of effective instructional techniques used by automotive technology instructors

Frederick Ernest Franke

AN ANALYSIS OF EFFECTIVE INSTRUCTIONAL TECHNIQUES USED BY AUTOMOTIVE TECHNOLOGY INSTRUCTORS

A Project

Presented to the

Faculty of

California State University,

San Bernardino

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

in

Education: Vocational Education Option

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ABSTRACT

The purpose of this project was to ascertain the effective instructional techniques being used by automotive technology instructors. In recent years our nation has emphasized excellence in education. Data has showed that those outcomes desirable in academics are a result of effective instructional techniques presently used in vocational education. Educational journals and books were reviewed to determine the effective instructional techniques being used by automotive technology instructors. This data was used to design a survey instrument to which twenty-five automotive technology instructors responded. The focus of this study was on the instructional techniques used, elements of those techniques, and how their effectiveness is determined.

ACKNOWLEDGEMENTS

I want to thank Dr. Ted Zimmerman for his patience and direction throughout the undertaking of this project. A special thanks to my wife, Maredith, for her understanding and encouragement.

TABLE OF CONTENTS

LIST TO TABLES

Chapter 1

Introduction

Background.

Is more than one instructional technique in automotive technology considered to be effective? How do automotive technology instructors perceive the effectiveness of techniques used in their instruction? Do these instructional techniques develop the desired student competencies in automotive technology? For years, it has been evident that vocational educators have been successful in developing student competencies using various instructional techniques. What has not been known is what individual educators perceive to be characteristic of an effective technique. Research has begun to isolate factors that make an instructional technique effective. These studies have indicated performance objectives are achieved when an instructional technique is combined with various necessary elements. It is the combination of these techniques and elements that produce effective teaching and learning.

Significance of the Problem.

Our nation has placed an emphasis on excellence in education. This was caused, to some extent, by a report known as "A Nation at Risk (Cross, 1992)." This caused a search for educational excellence and the strategies,

policies, and practices that will make students competitive in educational accomplishments with those from other countries. Data is beginning to show that useful and effective techniques are presently being used in vocational education. Those outcomes accomplished by the use of these techniques in vocational education are desirable in arena of academic education.

Statement of the Problem.

The career fields associated with vocational education apply all or part of the effective techniques desirable in academic instruction. This project will focus on the career cluster of automotive technology. It will attempt further to identify the effective techniques utilized by instructors of that cluster.

Purpose of the Study/Project.

The purpose of this project is to determine the effective instructional techniques used by automotive technology instructors including analysis of those elements considered by that group to make various techniques effective. The focus of the study is on the instructional techniques used, elements of those techniques, and how their effectiveness is determined.

Contribution of the Project.

At present, little information has been compiled on effective instructional techniques. That which is available only focus on individual programs. This project will add to that available information and give a more complete view of effective instructional techniques.

Previous studies have shown that an instructional technique is not effective in-and-of itself. There are other critical elements. This study may help vocational education instructors in evaluating the effectiveness of their programs.

Questions Addressed by the Project.

The purpose of this study is to analyze the effective instructional techniques used by automotive technology instructors. The questions addressed by this study are:

a. What are the instructional methods used by automotive technology instructors?

b. What are the effective "critical" elements included in that instruction?

c. What methods does the instructor use to determine the effectiveness of their techniques?

Limitations.

This research project was limited by the number of instructors in the field of automotive technology selected.

To allow completion of this project only a sample of 50 high school instructors from Riverside and San Bernardino counties were surveyed.

The project considers one career field in vocational education thereby reducing a broader analysis of effective instructional techniques.

Chapter 2

Review of Literature

Vocational Education Offers Effective Practices.

In recent years, there has been a search for educational excellence. The purpose is to discover what methods are effective. Vocational education already offers many effective and useful methods (Cross, 1992). In some instances, these methods are foreign to academic situations and are artificially created.

In a study by Bransford, Stein, Arbitman-Smith, and Vye (1985), methods were effective when learning takes place in context, learning is often guided, learning is useful, and the purpose of the learning is explained. Each of these characteristics is a vital part of vocational education and plays a part in a competency based program. Barryman and Baily (1992) said that: "these ideas are usually well grounded and small studies suggest the potential for spectacular improvements in learning (p 101)."

Learning styles have also become a major emphasis in education. To be effective a technique should meet the learning style of the individuals involved. According to Guskey (1989), this was an essential component of an effective instructional technique. As vocational education moves toward a competency based approach to instruction, it must also move toward individualized instruction. Since

individual students learn differently, instruction must be varied. Providing alternative methods to meet individual needs is the essence of individualized instruction (Knaak, 1983). The National Center for Research in Vocational Education defined individualized instruction as "instruction structured and managed to meet the learning needs of each student in a unique way in order to give each the skills, abilities, knowledge, and personal qualities that will enable him/her to enter the occupation of choice(1986)." Some vocational-technical school, such as 916 Area Vo-Tech Institute, White Bear Lake, Minnesota and Fox Valley Technical Institute, Appleton, Wisconsin, are beginning to apply learning styles research to their educational programs (Knaak, 1983).

Instructional Techniques Emphasized in Vocational Education.

Educational institutions, educators, and vocational leaders agree on the types of instructional techniques that are effective. Whether the course is automotive technology, agriculture, or construction, these techniques are effective for facilitating student learning.

Pendleton (1991) focused on four basic methods of instruction. These were demonstration, directed discovery, discussion, and lecture. The Model Curriculum Standards, Program Framework, and Process Guide for Industrial and

Technology Education in California State Department of Education (1990) focused on these same four instructional methods to be implemented for the seven career fields offered in the state of California.

There are some vocational leaders who indicate that the instructional techniques in vocational education should be performance oriented. As a result, instructional techniques should be distinguishable from those used in abstract academic fields. For this reason some vocational instructors abandon the lecture method as the least effective of the four methods mentioned. A recent study indicated that 12 percent of the full-time faculty in community colleges preferred the lecture style of teaching, but 11 percent of the full-time occupational/technical faculty also preferred to lecture most of the time (Cross, 1992). Vocational education is performance oriented and the lecture method should not be in the primary instructional technique.

Students bring a wide range of abilities, talents, and experiences to the learning environment. The instructional techniques used by the educator must meet a variety of needs. Variety in instructional techniques becomes critical. Variety can be provided by :(1.) varying the instructional technique and resources used, and (2.) offer alternatives from which students can choose (National Center

for Research in Vocational Education, 1986). This serves as a means of motivating students and holding their interest.

Elements of Effective Instructional Techniques.

The instructional techniques previously cited are not effective in-and-of themselves. For an instructional technique to be effective, other criteria must be met. It is the careful and systematic combination of other elements that do result in unusually effective teaching and learning (Guskey, 1989).

The first essential element is time. Research data indicates that the amount of time the student was actively engaged in learning contributes strongly to their achievement (U.S. Department of Education, 1986). The individual can take as much time as they need. The important factor is that the individual had met the performance objective; not the amount of time the student had used to complete the objective (Cory, 1990).

Another "critical" element is assessment. This has become a major concern in education. Vocational education offers continuous assessment and feedback to students. In most situations, and individual must complete certain competencies before they progress to the next level. This is primarily intended as feedback for students (rather than a mechanism for grading) and which are used to identify and correct individual learning errors (Gusky, 1989). When

students have knowledge of their learning progress, performance will be superior to what it would have been without such knowledge (Budke, 1988).

Explaining exactly what students are expected to do was another important element of effective instructional techniques. This element takes into consideration that knowing how to learn may not come naturally to all students and allows the individual to progress at their own pace. Data from the U.S. Department of Education (1986) stated, "When teachers explain exactly what students are expected to learn....students learn more." Students learn more quickly and effectively when they are told in advance what it is that they are expected to be able to do as a result of the instruction (Pendleton, (1991).

The final element discussed in literature was high expectation. It has long been observed that students will learn what teachers expect them to learn. High teacher expectations result in increased and more effective instruction (Budke, 1988). Teachers who expected a great deal from their students and pressed them to work very hard found that nearly all students attained a very high level of achievement. (Guskey, 1989).

These elements were considered important additives in order for instructional techniques to be effective.

According to Guskey (1989), these findings should not be a surprise to vocational educators since these elements are "common sense (p 21)."

Importance of Computer Technology.

Computer technology has become important to many career fields. This is particularly true of automotive technology. In 1990, just 18 percent of a car's functions were controlled by a computer. In 1994, 83 percent of an automobile's operations were controlled (Mulford, 1994).

In automotive technology effective instructional techniques must include computer based technology. Most engine problems are discovered by hooking the car up to a computer. Computer technology is a major part of the automotive industry. For an automotive program to be credible, computer technology must be part of the instructional technique (Mulford, 1994).

Computer-aided instruction has led to the creation of "intelligent tutoring systems" (Ross, 1994). These systems react to and guide students on their skills, choices, and situations. Using these systems, students diagnose different problems by listening to the changing sounds of an engine, study the flow of engine fluids or observe moving parts displayed with graphics. Software packages insert faults into a car's engine or electronic components to help students troubleshoot. Software-controlled simulators

depict lifelike examples of problems with a car's components.

Ross (1994) indicated that use of intelligent tutoring systems gave the students many advantages. Designed around active learning, they increased motivation and helped teach the problem solving, math, writing, and decision making skills employers demanded.

Use of Models.

Preparing individuals who can meet competency levels in the work place should be a concern of all vocational educators. Some educators will design their own program from the ground up, including instructional techniques. Others will use models established by industry.

For automotive technology, the National Institute of Automotive Service Excellence (ASE) is such a model. ASE is the only industry-wide national certification program for automotive technicians. The National Automotive Technicians Education Foundation (NATEF), the education arm of ASE, began certifying school automotive programs in 1983. As a member of ASE/NATEF, a school can be assured of meeting the standards of the automotive industry (Sutphin, 1994). By following the standards and certification process, a school program can be assured of having an effective program.

Another model was an outcome-based model for automotive technology offered by Porche. The model involved pretesting

students to determine their level of knowledge and background, teaching with demonstrations, student practice with a heavy emphasis on peer coaching, reteaching and retesting. What made Porche's model effective was that instructors would vary teaching and assessment methods as often as it took to insure that students really did learn a specific task and were able to perform it well. Students were not just turned loose to work on an assignment. Even in a team of assignment, the instructor knew what every individual was capable of doing. The key to Porche's instructional model was that outcome-based education is to decide what tasks students need to be able to perform and work backward to find the skills that must be mastered (Luft, 1994). This process would determine what instructional techniques would be used.

Literature indicated a variety of effective instructional techniques. The techniques ranged from educational dictates, necessary elements, computer technology, and industrial models. Each educator had their own opinion as to what was an effective instructional technique based on their own experience or research. Instructional techniques were considered effective when the stated performance objectives were reached by the student.

Chapter 3

Design and Procedures

Subjects.

The subjects in this study were 50 automotive technology instructors (in secondary institutions and/or ROP programs) from Riverside and San Bernardino counties. Twenty-five (50%) of the surveys were completed and returned.

Instrumentation/Data Collection.

The instrument (See Appendixes 1-4) used in this study was a semantic differential scale. The survey included eight questions aimed at assessing the methods of instruction, eight question to assess the elements of instruction, and five question to assess the methods used to evaluate their instructional methods. Individual responded to the questions by marking the appropriate reply; Always, Most of the Time, N/A, Rarely, or Never.

Data Treatment Procedures.

The survey was mailed to each of the fifty instructors. A return addressed envelope was included with the survey. The individuals were allowed a three week period to complete and return the survey.

After the data was collected it was analyzed in terms of positive and negative responses to the questions. These responses were totaled and displayed on Tables 1, 2, and 3.

The individual replies to each question were displayed in Appendixes B, C, and D.

Chapter 4

Findings and Discussion

Instructional Techniques Used.

The responses to the first category of questions on the survey indicated which techniques are being used by automotive technology instructors. Eighteen used the lecture method most of the time. The most frequently used methods were demonstrations, projects, individualized instruction, job sheets, and guided practice. Seven said they used each of these methods and thirteen said they used these methods most of the time.(Table 1)

Table 1

DESCRIPTIVE TOTALS OF INSTRUCTIONAL TECHNIQUES

Techniques	Positive Responses	Negative Responses
Lectures	18	7
Demonstration	22	3
Projects	22	3
Individualized Instruction	22	3
Job Sheets	20	5
Guided Practice	22	3
Computer-aided Instruction	6	19

Positive Responses = Always + Most of the Time Responses

Negative Responses = N/A, Rarely, and Never Responses.

The least used method was computer-aided instruction. Only three of the instructors always use computer-aided

instruction or used the method most of the time. Five said that the use of the method did not apply. Eight said they never use the method.(Table 1)

The lecture method received the most positive responses (18). Computer-aided instruction received the most negative responses (19).(Table 1)

Elements of Instruction Used in the Programs.

These elements were considered "critical" if instructional techniques were to be considered effective.

Continuous feedback and explaining all performance objectives before instruction began were elements that received all twenty-five positive responses. Thirteen instructors that their instruction is designed to meet a variety of learning styles.(Table 2.)

Twelve instructors indicated that the pre-assessment of the student's subject knowledge was incorporated into their instructional techniques. Thirteen responded negatively to the use of this element. The same was true of learning style assessment. Thirteen incorporated this into their instruction and twelve responded negatively.(Table 2)

Table 2

DESCRIPTIVE TOTALS OF INSTRUCTIONAL ELEMENTS

Elements	Positive Responses	Negative Responses
Continuous feedback	25	
Explanation of performance objectives	25	
Variety of learning styles	23	2
Pre-assessment of students knowledge of subject	12	13
Completion of performance objectives	17	8
Assessment of learning styles	13	12
Incorporation of ASE Standards	15	10
NATEF Certification	12	13

Positive Responses = (Always + Most of the Time Responses)

Negative Responses = (N/A + Rarely + Never Responses)

The completion of performance objectives was more important than the time it took to complete the performance objective was indicated by seventeen instructors. Four indicated that time was more important.(Table 2)

ASE standards are incorporated into the programs of fifteen instructors. Ten instructors gave a negative response. Twelve instructors incorporate NATEF certification into their program. Thirteen gave a negative response to this question.(Table 2)

Effectiveness of Instructional Techniques.

The questions in this section of the survey focused on the methods instructors use to determine the effectiveness of their instructional techniques.

Instructors indicated that most evaluated student achievement through the use of an evaluation instrument or by class discussion. The least used method was an open-ended written evaluation.(Table 3)

The majority of instructors (21) indicated that the use of observing nonverbal reaction was the most effective way of acquiring feedback from students. Twenty instructors indicated that informal discussion was the second most used method. The least used was a checklist or other data gathering instruments.(Table 3)

Informal discussions and a positive conference between teacher and observer were the most used by instructors to gain feedback from teachers, supervisors, and administrators. The methods receiving a negative response were classroom visitation and classroom visitation with the observer filling out a checklist.(Table 3)

The method used frequently for self-evaluation was the instructor evaluating their own lesson plans. Only one instructor used self-taping as a means of self-evaluation.(Table 3)

Regarding the evaluation of instructional effectiveness, instructors first choice was feedback from students (21 positive responses). The second choice was themselves (33 positive responses). The last choice of a source of evaluating instructional effectiveness was other teachers (14 negative responses).(Table 3)

Table 3

DESCRIPTIVE TOTALS OF METHODS USED TO DETERMINE INSTRUCTIONAL EFFECTIVENESS

Method	Positive Response	Negative Response
1. Of evaluating student achievement.		
a. Class discussions	18	7
b. Open-ended written evaluation	13	12
c. Evaluation instrument	21	4
d. Other	13	12
2. Of acquiring feedback on teachers effectiveness from students.		
a. Informal discussions	20	5
b. Classroom visitation	14	11
c. Classroom visitation with observer filling out a checklist	15	10
d. Positive conference between teacher and observer	16	9
4. Of self-evaluation.		
a. Self-taping	1	24
b. Other teachers	11	14
c. Self	22	3
d. Others	16	9

Table 3 (cont.)

Method	Positive Response	Negative Response
5. Of evaluating instructional effectiveness.		
a. Students	23	2
b. Other teachers	11	14
c. Self	22	3
d. Others	16	9

Positive Response = (Always + Most of the Time Responses)

Negative Response = (N/A + Rarely + Never Responses)

Chapter 5

Conclusion and Recommendations

Conclusion.

A variety of instructional techniques are being used by automotive technology instructors. The data collected indicates that those techniques deemed important to vocational education are being utilized by these instructors, yet the lecture method was still a dominant technique. This deters from those who have indicated that instructional techniques in vocational education should be performance oriented.

Computer technology is the wave of the future. This has a major effect on the automobile. Almost all of an automobile's functions are controlled by a computer. The data collected indicated that few instructors were using computer-aided instruction. With the lack of computer-aided instruction, the value and credibility of these programs could be questioned.

"Critical" elements were considered necessary for effective instruction. Continuous feedback, explaining performance objectives, and meeting a variety of learning styles were emphasized. The data collected indicated automotive technology instructors included these elements in their instructional techniques.

The incorporation of the other "critical" elements is divisive. Some instructors do not include these elements that are deemed necessary for effective instruction. Many instructors did not include ASE standards or NATEF certification into their programs. Again, this creates a question of credibility and/or the effectiveness of their programs.

Feedback is important to the evaluation of instructional effectiveness. The data indicated that instructors were making efforts to evaluate their instructional techniques. Informal discussion, observation, and written evaluation were the primary methods used for determining the effectiveness of instructional techniques.

Instructors allowed for little positive or negative criticism in evaluating themselves and their instructional effectiveness. In most instances the instructor was the primary evaluator. The perception of effectiveness rested with the instructor.

As the search for educational excellence continues, vocational education is moving in the right direction. There is still room for improvement. The greatest need is for vocational educational instructors to continue to develop effective instructional techniques that include those elements which make instructional methods effective.

Recommendations.

Future studies could focus on a comparison of effective instructional techniques in automotive technology with another career field. Another comparison study could focus on automotive technology in other states. It would be interesting to study a program in which the lecture techniques had been eliminated. A final recommendation is in regards to a study focusing on the validation of automotive technology programs which do not incorporated computer-aided instruction.

APPENDIX A

Survey Instrument

Fred E. Franke
10659 Hawthorne
Hesperia, California 92345

May 22, 1995

Dear Automotive Technology Teacher:

As a graduate student completing a Masters of Arts in vocational education at California State University, San Bernardino, I am conducting a study to determine what instructional techniques automotive technology instructors are using and the effective elements of that instruction. It is hoped that results of this study will help improve vocational teacher training and teaching effectiveness for all vocational teachers in California.

Your response to the questionnaire is very critical source of data for providing a cross-section of vocational teachers in Riverside and San Bernardino counties. You may be assured your response will be strictly **confidential** and no identifying information will be released to anyone. A response should take less than ten minutes of your time. It is critical to the success of the study.

Please complete the questionnaire and return it in the enclosed envelope by June 7, 1995. The study has the endorsement of the Department of Vocational Education at California State University, San Bernardino, as an integral component of determining vocational training effectiveness.

Your cooperation is greatly appreciated.

Sincerely,

Fred E. Franke

Ted H. Zimmerman
Master of Arts Advisor,
Vocational Education
California State University,
San Bernardino

Effective Instructional Techniques
Survey Instrument

Please respond to the following questions by marking an **X** in the space that best represents your use of instructional techniques in automotive technology.

	Frequency of Use				
	Always	**Most of the time**	**N/A**	**Rarely**	**Never**
1. Instructional techniques used:					
a. Lectures.					
b. Demonstrations.					
c. Direct discovery:					
1) Projects.					
2) Individualized instruction.					
3) Job sheets.					
4) Guided practice.					
d. Computer aided instruction.					
2. Elements of instruction in my program:					
a. Students receive continuous feedback.					
b. All performance objectives are explained before instruction begins.					
c. Instructional techniques are designed to meet a variety of learning styles.					
d. Before instruction begins, each student's knowledge of the subject area is assessed.					

	Always	Most of the time	N/A	Rarely	Never
e. Completing performance objective is more important than the amount of time it takes to complete the objective					
f. Before instruction begins, each student's learning style is assessed.					
g. Competency-based instruction is related to standards set by the Institute of Automotive Service Excellence.					
h. National Automotive Technicians Educational Foundation certification is incorporated into competency-based instruction.					
3. Methods used to determine the effectiveness of instructional techniques.					
a. One or more of the following evaluation methods are used to evaluate student achievement:					
1) Class discussion.					
2) Open-ended written evaluation.					
3) Evaluation instruments.					
4) Other (please list below).					
b. One or more of the following evaluation methods are used to get feedback on teacher effectiveness from students:					

	Always	Most of the time	N/A	Rarely	Never
1) Informal discussion.					
2) Observation of their nonverbal reactions.					
3) Checklist or other data-gathering instrument.					
c. One or more of the following evaluation methods are used to get feedback from other teachers, supervisors, and administrators:					
1) Informal discussion.					
2) Classroom visitation.					
3) Classroom visitation with observer filing out checklist or other evaluation instruments.					
4) Positive conference between teacher and observer.					
d. One ore more of the following methods are used for self evaluation purposes:					
1) Viewing a videotape of self instructing the class.					
2) Completing a self-evaluation instrument.					
3) Evaluating own lessons plans following the lesson presentation.					
e. The following sources of information for evaluating instructional effectiveness are:					
1) Students.					
2) Other teachers.					
3) Self.					
4) Others(e.g. parents, employers)					

APPENDIX B

Instructional Techniques Quantified

INSTRUCTIONAL TECHNIQUES QUANTIFIED

Elements	Frequency of Use				
	Always	Most of the Time	N/A	Rarely	Never
Lectures		18		7	
Demonstrations	8	14		3	
Projects	8	14		3	
Individualized Instruction	8	14		3	
Job Sheets	7	13		5	
Guided Practice	7	15		2	1
Computer-aided Instruction	3	3	5	6	8

APPENDIX C

Elements of Instruction Quantified

ELEMENTS OF INSTRUCTION QUANTIFIED

Elements	Frequency of Use				
	Always	Most of The Time	N/A	Rarely	Never
Continuous feedback	13	12			
Explanation of performance objectives	13	12		3	
Variety of learning styles	8	15			
Pre-assessment of students knowledge of subject	3	9	1	10	2
Completion of performance objectives	6	11	1	3	4
Assessment of learning styles	4	9	1	9	2
Incorporation of ASE standards	7	8	2	6	2
NATEF Certification	4	8	2	6	5

APPENDIX D

Methods Used to Determine the Effectiveness of Instructional Techniques Quantified

METHODS USED TO DETERMINE THE EFFECTIVENESS OF INSTRUCTIONAL TECHNIQUES QUANTIFIED

Methods	Frequency of Use				
	Always	Most of the Time	N/A	Rarely	Never
1. Of evaluating student achievement.					
a. Class discussion	5	13	1	4	2
b. Open-ended written evaluation	2	11	2	7	3
c. Evaluation instrument	5	16	1	3	
d. Other	5	8	3	4	5
2. Of acquiring feedback on teacher effectiveness from students.					
a. Informal discussions	8	12	2	3	
b. Observation of nonverbal reactions	10	11	1	3	
c. Checklist or other data-gathering instrument	5	10	4	5	1
3. Of acquiring feedback from other teachers, supervisors, and administrators.					
a. Informal discussions	4	16		5	
b. Classroom visitation	3	11		11	
c. Classrooms visitation with observer filling out a checklist	5	10	4	5	1

Methods	Always	Most of the Time	N/A	Rarely	Never
d. Positive conference between teacher and observer	2	14		6	3
4. Of self-evaluation.					
a. Self-taping		1	2	12	10
b. Self-evaluation instrument		4	3	9	9
c. Evaluating own lesson plans	5	13		3	4
5. Of evaluating instructional effectiveness.					
a. Students	12	11		2	
b. Other teachers	3	8		11	3
c. Self	8	14		3	
d. Others	6	10		6	3

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